

Eastern
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Edition

Introduction to

Chemical Engineering

S. Pushpavanam



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S. Pushpavanam

Professor and Head
Chemical Engineering Department
Indian Institute of Technology Madras

PHI Learning Private Limited

New Delhi-110001

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S. Pushpavanam

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Preface

This book is an outgrowth of my teaching the course on *Introduction to Chemical Engineering* (CH1010) for the first time to the fresh undergraduate students of IIT Madras in the July–December 2009 semester. Never having taught a fresh class before (in a career of twenty years), I was impressed to see the students looking young, fresh, motivated, and eager to learn. Attendance in the class was close to a 100% and this was in itself something I, as an instructor, could look forward to. It was nice to experience the eagerness and the enthusiasm of the students to learn and experiment. There was a healthy interaction during all the lectures, with students putting questions, which was a positive sign. The course is extremely important as it sets the tone in the minds of the students about the entire four-year degree programme. Getting the right instructor and the right set of course contents can get the students a good feeling about the programme they are in and can make them stay motivated throughout the programme. It can be the determining force as to whether the students are attracted to or repelled from their major discipline “chemical engineering”.

There was an intense discussion amongst the faculty of IIT Madras on the modes and methods for teaching this course during the January–March 2009 semester. One point of view was to have different faculty exposing the students to the different areas of chemical engineering. Here each faculty would introduce the students to his research area in a couple of lectures. The proponents of this approach were of the opinion that this would help match the aptitudes of students to different research areas in chemical engineering. The drawback here would be that the students were just out of school and would not be mature enough and ready for exposure to research challenges. Administratively, there would be no single person accountable for the quality of the course. Moreover, there would be an inherent discontinuity in this approach with different research areas being covered over short intervals of time. The differences in the style of teaching would also result in a course which is not cohesive. The frequent changes in the style would leave the students confused. Subsequently, it was felt that adopting this approach would not be fair to the students.

Being the first course in which the students would be exposed to the department it was necessary that the person teaching the course keep in mind that he must make the discipline attractive and informative. To be effective the course had to be designed keeping in mind the intellectual and the social backgrounds of the students and their maturity levels. The final shape of this course and the contents of this book have been strongly influenced by Professor Krishnaiah, my teacher and guru, as well as Niket Kaisare, a young colleague of mine. I think if I had not agreed to teach the course the arguments amongst my faculty colleagues could have been continuing even today.

The contents of the course have been developed keeping in mind the educational background of the (10+2) school students who upon joining the engineering education would like to know the relevance of their school education to the chemical engineering profession. The book is therefore aimed primarily at the first-year students of engineering, who already have a background in the basic sciences: physics, chemistry, and mathematics. They are trained to solve problems in these subjects and are trained to think that all problems have unique answers.

One of the objectives of the book is also to introduce the students to lateral thinking so that they realize that a problem may have different solutions. The examples and assignments in this book have been chosen to drive home the point that solutions to a problem in the real world do not have to be unique. The emphasis is to show how common sense combined with a strong fundamental scientific knowledge is the basic quality necessary to be a good engineer. This would help an engineer find innovative solutions.

The book explains the issues involved in the chemical engineering discipline and shows how the concepts of physics, chemistry, biology, and mathematics are used in solving them. In addition to this, there is also a section on ethics to help students understand their role in society. Most of the case studies for the ethics section are from realistic but hypothetical situations and have been chosen such that the students identify themselves with them.

The examples and different topics covered in the book have been arrived at on the basis of informal discussions with several colleagues in the corridors of IIT Madras. As a part of this course, students were taken to the water treatment plant in the swimming pool, the reverse osmosis (RO) plant which provides drinking water to the students and the liquid nitrogen plant. All these are located in the institute. This made them understand the level of details an engineer has to be concerned with when it comes to designing and running a process plant. These plants have backup features in case certain units fail, and features such as these can be best appreciated only during a site visit. Similar plants would be present in other colleges and can be ideal for students to get a practical feel of the basic principles of chemical engineering.

I express my sincere thanks to my colleagues Ramanathan, Nagarajan, and Sethupathi from IIT Madras for providing valuable inputs to several sections of the book. Renganathan went through the entire manuscript with a magnifying

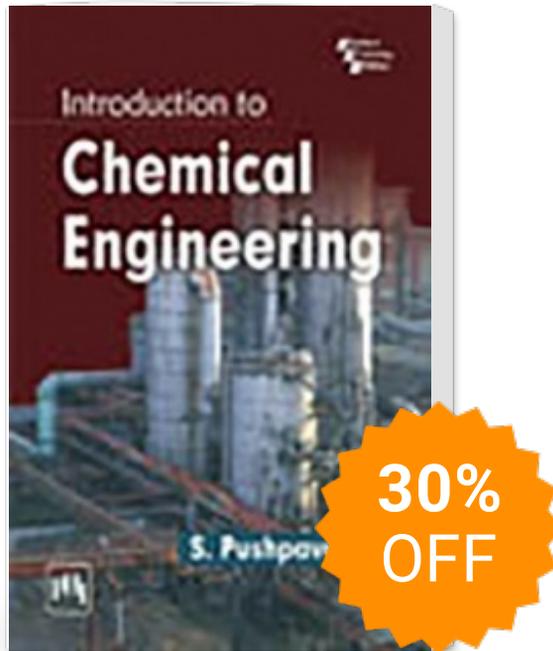
glass and provided several critical inputs and suggestions to improve its quality. My students—Manoj Yadav, Hemalatha, Ravikanth, Varshaa Naganathan, and Ashraf Ali—helped with the figures and programs in the text. Jason, in particular, went through the entire manuscript and provided a student’s perspective to help improve the contents.

The book would not have been possible without the encouragement and support of my wife, Geetha. My cousin Madhusoodhanan also played an important role by prompting me every time we met as to when the next book was coming out.

Finally, I would like to thank the Centre for Continuing Education, IIT Madras for financial support for writing this book.

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